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Factors Affecting Innovation within Aeronautical Systems Center (ASC) Organizations - An Inductive Study

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THESIS

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Abstract

In response to the Air Force transformation movement there is currently a lot of high level interest in instilling cultures that promote innovation and intelligent risk taking in Air Force organizations. This thesis analyzed data collected during the 2002 Chief of Staff of the Air Force Organizational Climate Survey to identify factors that affect innovation within Aeronautical Systems Center (ASC) organizations. A secondary purpose of this study was to identify current enablers or barriers to innovation within these organizations. The first part of the study utilized multiple linear regression to identify the factors within the survey that were most related to the questions that measured innovation. These results were used to form propositions about factors that affect innovation within ASC organizations. The second part of the study utilized content analysis techniques on the comment section of the survey to identify current trends that may be enabling or blocking innovation within the participating organizations. The results of the study include seven propositions about factors that influence innovation that can be tested in follow-on research and several trends that provide insight into ASC personnel's thoughts on innovation at the time that the survey was administered. The seven propositions identified in the study are:

P1: Organizations with heavy work loads and good teamwork are more innovative
P2: Units that listen to and implement their personnel's ideas are more innovative.
P3: Units that have personnel with a wide breadth of skills are more innovative.
P4: Units that adapt to change are more innovative.
P5: Organizations with trusted leaders are more innovative.
P6: Units with low morale are more innovative.
P7: Personnel must be equipped with the proper tools and equipment to help foster an innovative atmosphere within an organization.

FACTORS AFFECTING INNOVATION WITHIN AERONAUTICAL SYSTEMS CENTER (ASC) ORGANIZATIONS – AN INDUCTIVE STUDY

I. Introduction

Statement of the Problem

In response to the Air Force Transformation movement, organizations are expected to instill an organizational culture that rewards innovation and intelligent risk taking. Senior Air Force leaders are mandating that United States Air Force (USAF) organizations strive for innovative workplaces but there has been very little research to identify what factors affect innovation in military organizations. This research effort intends to address this shortfall by identifying factors that affect innovation in Aeronautical Systems Center (ASC) organizations.

Background

The Acquisition Reform movement is driving high level interest in changing the organizational culture of Air Force units to encourage and reward innovation and smart risk taking. Dr. Marvin Sambur, Assistant Secretary of the Air Force for Acquisition stated, "My charge from the secretary is to foster a culture of innovation and reasonable risk taking. Only if we do this will we be able to shorten acquisition cycle times, insert new technologies into systems throughout their life cycles and deliver today's technology today."(AF News, 2001:2) To help guide acquisition reform the office of the Secretary of the Air Force for Acquisition released a new series of reform initiatives, called "Lightning Bolts" in 2002. Lightning Bolt number four, entitled "Breeding Innovators", directly addresses the need for a cultural change in Air Force organizations. This

initiative calls for the establishment of an Acquisition "Change Culture University" where Air Force personnel will be trained on implementing innovation. The initiative also requires that all commanders and executive directors to be held accountable for cultural change within their organizations. Locally, the Aeronautical Systems Center (ASC) at Wright-Patterson Air Force Base is also addressing cultural change in their transformation effort. In his March, 2002 commanders call, the ASC commander, Lt. Gen. Reynolds, identified workforce, speed, and innovation as keys to mission success. ASC has also assigned a culture champion team with the objective of encouraging and rewarding innovation, speed, and smart risk-taking.

There has been very little written about innovation in the military. Most of the literature that is available on this topic covers ways to innovate on the battlefield to ensure success. During the literature review I was unable to find any current research on innovation in the operation and management of military organizations. There appears to be a gap in the research that covers process and organizational innovation throughout military organizations. The Air Force transformation movement has identified a need for change within the organizational cultures in Air Force units, specifically, organizations must be more innovative and reward intelligent risk taking. Department of Defense Directive 5000.1, *The Defense Acquisition System,* clearly points out the need for innovation within the military:

> Decision-makers at all levels shall encourage the continuous examination and adoption of innovative practices – including best commercial practices and electronic business solutions - that reduce cycle time and cost, and encourage teamwork, and shall provide meaningful incentives for innovation, such as reinvestment of cost savings and career recognition and advancement. In addition, decision-makers at all levels shall encourage and facilitate the documentation and institutionalization of lessons learned – both good and bad - from past experience. Proper incentives must

> be in place to encourage a culture friendly to the documentation of valuable lessons learned and the sharing of knowledge. The objective is a learning culture that embraces change and continuously adapts to new challenges. (DoD 5000.1, 2000: 9)

An interesting point made in this extract is that innovation adoption must be infused throughout the organization at all levels.

The DoD's push to create an innovative culture is further supported by the following passage from the Federal Acquisition Regulation (FAR):

> "...If a policy or procedure, or a particular strategy or practice, is in the best interest of the Government & is not specifically addressed in the FAR, nor prohibited … the Team should not assume it is prohibited. Rather, absence of direction should be interpreted as permitting the team to innovate & use sound business judgment that is otherwise consistent with law & within the limits of their authority." (FAR Part 1.102-4(e))

Brig. Gen. Scott, the Deputy Assistant Secretary for Contracting and Assistant Secretary for Acquisition, showed his support for fostering innovation in the acquisition community in his 30 Jan, 2003 briefing entitled "Air Force Contracting – View From the Top", when he stated that we "must become a community of innovative, even daring risk takers." It is clear that the need to innovate is a high priority to DoD and Air Force leaders, but little is known about how to instill an innovative mindset in military units.

Scope

Because the literature review failed to uncover a common theory for innovation within military organizations, this research was an inductive study with the goal of identifying factors that affect innovation within ASC organizations. A secondary goal of this research was to identify current barriers and enablers to innovation within the participating ASC organizations.

Research Approach

This research effort was an inductive effort. Inductive research begins with specific observations and measures, tries to detect patterns and regularities, then formulates some tentative propositions that can be explored, and finally ends up developing some general conclusions or theories that can be tested in follow-on research. This effort will utilize two approaches. The first step will be to identify questions addressing innovation from the 2002 Chief of Staff of the Air Force (CSAF) Organizational Climate Survey. The definitions found in the literature review will help identify the questions that deal with innovation within the survey. Once these questions are identified a regression test, utilizing the participating organizations CSAF survey data, will be run to isolate the factors that are most correlated to innovation within the organizations. The results from all of the questions identified as dealing with innovation will then be compared to find trends and form propositions about which factors affect organizational innovation the most. The resulting propositions can then be tested in later research. The second approach in this research effort will be to perform a content analysis on the comment section from the survey to identify any barriers or enablers to innovation within the participating organizations.

Maximum Expected Gain

This research effort intends to identify and isolate factors that influence innovation within ASC organizations and to form testable propositions based upon these findings. The propositions will be useful for future research on organizational innovation. The propositions produced by this study can be tested deductively in follow-on research to see if there is enough support to form hypotheses. A secondary purpose of

this research is to identify barriers to, and enablers of innovation within current ASC organizations. Once these barriers and enablers are identified, Commanders can take actions to reduce the barriers and enhance the enablers to foster a more innovative culture within their organization. In addition the findings may be of value when developing a curriculum for future innovation and cultural change training for Air Force members.

II. Literature Review

Introduction

When people think of innovations they often mistakenly believe that innovations occur only in high-tech environments. According to Neely, "Innovation in products, processes and services can appear in all sectors of economic activity spanning from traditional to high-tech, public to market, industrial, agricultural or tertiary" (Neely, 1998:9). As both the private and public sectors have increased their focus on innovation over the last twenty years, the literature has provided various definitions. This literature review, covering the most current literature available on innovation in the private sector and the military, provides several current definitions of innovation, reasons why private companies emphasize innovation, and the incentives behind the United States Air Force focus on innovation. It then covers barriers and enablers to innovation in both the Air Force and the private sector.

What is Innovation?

With the emergence of innovation as a top priority to management in both the public and private business community, the volume of literature on this subject has increased a great deal in recent years. Despite the increased interest and research on innovation, no dominant theory or definition has emerged (Drazin and Schoonhoven, 1996:1065; Nohria and Gulati, 1996:1251). According to Damanpour, understanding innovation is difficult due to "the often contradictory and inconsistent results of research studies" (Damanpour, 1988: 545). Wolfe also observed the lack of a common definition when he noted, "there can be no one theory of innovation, as the more we learn, the more

we realize that 'the whole' remains beyond our grasp" (Wolfe, 1994: 405). Likewise, Gleeson pointed out that the lack of a standard definition for innovation results in the miscommunication and misinterpretation of ideas (Gleeson, 1998: 1).

From the wide range and variety of literature on innovation this literature review lists some of the more prevalent definitions being used by researchers today and identifies the definition that best fits this research. In its simplest sense, innovation is the act of introducing something new (Funk & Wagnalls, 1980: 395). A more technical definition is considered by Van de Ven; "The process of innovation is defined as the development and implementation of new ideas by people who over time engage in transactions with others within an institutional context" (Van de Ven, 1986: 590; Kanter, 1988: 160). This interpretation adds the implementation of the idea to the previous definition that just covered the introduction of the idea itself. The addition of implementation to the basic definition is also supported by Freemen who made the distinction between invention and innovation. He said that "an invention is an idea, sketch or model for a new or improved device, product process or system" and "an innovation in the economic sense is accomplished only with the first commercial transaction involving the new product, process, system or device…" (Freeman, 1982: 5). Amabile and Conti also support this definition; they believe that innovation is the successful implementation of creative ideas within organizations (Amabile and Conti, 1996: 1154). A large proportion of the available literature supports the definition that innovation includes the implementation, not just the introduction of new ideas, products or processes.

An innovation does not have to be a completely new idea, just new to those that are pursuing it for the first time. According to Nord and Tucker, an innovation is "a technology or a practice being used for the first time by members of an organization, whether or not other organizations have used it previously" (Nord and Tucker, 1987:6). Nohria and Gulati share this view by defining innovation "to include any policy, structure, method or process, product or market opportunity that the manager of the innovating unit perceived to be new" (Nohria and Gulati, 1996: 1251). Van de Ven also shows support for this interpretation when he says "As long as the idea is perceived as new to the people involved, it is an innovation, even though it may appear to others to be an imitation of something that exists elsewhere" (Van de Ven, 1986:591). Because this research effort is an inductive study, a broad definition of innovation was chosen as the basis for this thesis. The European Union Green Paper on Innovation cited in Neely's report states:

> In brief, innovation is:
> - The renewal and enlargement of the range of products and services and the associated markets;
> - The establishment of new methods of production, supply, and distribution;
> - The introduction of change in management, work organization, and the working conditions and skills of the workforce. (Neely, 1998: 9)

This definition is sufficiently broad to cover innovations throughout products, processes, and organizations.

Types of Innovation

The literature divides innovation into three distinct types: product innovation, process innovation, and organizational innovation. Product innovation includes new or improved products, services, or equipment. Process innovation includes new or

improved processes such as manufacturing, purchasing, or distributing. Organizational innovation is the new or improved use of organizational resources (Neely, 1998: 9). Within these classes, innovations can be further broken into incremental and radical. A radical innovation provides a sudden breakthrough while an incremental one shows steady progression over time (Neely, 1998: 9; Leifer, O'conner and Rice, 2001: 103). Constantino Markides, Professor of Strategic and International Management and Chairman of the Strategy Department at the London Business School has also classified innovations into similar categories: complementary or disruptive (Mang, 2000: 45). Gluck describes the two types as incremental and Big Bang innovations (Gluck, 1985: 7).

Why Innovate?

Over ten years ago IDEO, an award winning design firm based in the Silicon Valley, performed a study to find out why companies looked outside of their organizations for new product development. They found that there were four reasons. The reasons were, in order: Capacity, most businesses didn't have the internal resources required to meet the need for new product development. The second reason was speed; they needed to meet extremely tight deadlines. The third reason was the need for an expertise that was currently lacking within the company. The final reason was innovation. Since the original study Tom Kelley, the General Manager of IDEO, has noticed a new trend. Innovation, which was fourth on the list during the initial study, is now on top of the list. Mr. Kelley has noted that among senior executives it is now accepted that innovation is at the center of corporate strategies and initiatives (Kelley, 2001: 3). Sutherland, Hartmann and Seidel proclaim, "Innovation is the most effective

way to differentiate from the competition" (Sutherland, Hartmann and Seidel, 2002: 33). Chen and Ho add, "innovation may be the only sustainable competitive advantage in today's economy" (Chen and Ho, 2002: 46). Nohria and Gulati state, "Innovation has been an outcome of central interest to organization theorists because it is vital for organizational adaptation and renewal" (Nohria and Gulati, 1996: 1245). Research has also shown that companies that are known for innovation are valued higher by financial markets (Chen and Ho, 2002: 46). Low and Kalufut point out that innovation "has always been a key to business success and wealth creation" and that it "has always been a central driver to economic development" (Low and Kalafut, 2002: 75).

These statements are supported by research conducted by the Center for Business Innovation (CBI). Innovation was shown to be at or near the top of value drivers in many industries (See Figure 1). The following chart is the result of research conducted by CBI, the purpose of the research was to help define and weigh the importance of nonfinancial value drivers across different markets (Chen and Ho, 2002: 47).

Innovation A Top Value Driver	
B2B **1. Innovation** 2. Customer 3. Brand 4. Globalization 5. Quality	B2C **1. Innovation** 2. Brand 3. Customer 4. Quality 5. Survivability
Durable Manufacturing **1. Innovation** 2. Management 3. Employee 4. Quality 5. Environment	Non-Durable Manufacturing **1. Innovation** 2. Employee 3. Management 4. Alliances 5. Quality
Tech Infrastructure 1. Management **2. Innovation** 3. Quality 4. Workplace 5. Environment	Consulting Services 1. Quality **2. Innovation** 3. Employee 4. Technology

Figure 1: CGE&Y Value Creation Index
Source: Cap Gemini Ernst and Young Center for Business Innovation

The results shown in the chart support the literature that highlights the emphasis placed on innovation in the marketplace today. Low and Kalafut point out that product innovation alone is not sufficient to remain competitive in today's market. Innovation should not be pursued only in the research divisions of companies but throughout all aspects of the business (Low and Kalafut, 2002: 75).

Why the Air Force Must Innovate

To this point all of the literature reviewed has covered privately held, for profit companies. Very little has been written about innovation in the military. Most of the literature that is available on this topic covers ways to innovate on the battlefield to ensure success. Little has been written on innovation in the operation and management of military organizations (Pardo, Cresswell, Zhang and Thompson, 2001: A1). There

appears to be a gap in the research that covers process and organizational innovation throughout military organizations. The Air Force transformation movement has identified a need for change within the organizational cultures in Air Force units, specifically, organizations must be more innovative and reward intelligent risk taking. Department of Defense Directive 5000.1, *The Defense Acquisition System,* clearly points out the need for innovation within the military:

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In an article that appears in *Concepts for Air Force Leadership*, Dr. William Klemm states, "Leaders know in their gut that creativity and innovation are the life blood of their organization" (Klemm, 2001: 2). He also identifies the need for leaders to stimulate creativity to increase productivity and prevent obsolescence. The Army Corps of Engineers advocates Business Process Innovation (BPI) as the tool to implement innovation while the Air Force equates innovation with Business Process Reengineering (BPR). BPI and BPR are synonymous and are defined as "the fundamental rethinking and radical redesign of business processes to achieve dramatic improvements in critical, contemporary measures of performance, such as cost, quality, service, and speed" (Hammer and Champy, 2001: 35).

Barriers to Innovation

Implementing innovation into an organizational culture is rarely easy. There are many barriers to innovation, both internally and externally. Internal barriers consist of rigid organizations and procedures, hierarchal and formal communication structures, conservatism, conformity and lack of vision, resistance to change, lack of motivation, and risk avoiding attitudes. External barriers include: lack of infrastructure, deficiencies in education and training systems, inappropriate legislation, and the overall neglect and misuse of talents in society (Neely, 1998: 5). Wiig and Wood, as reported by Neely in his research, also identified barriers to product and process innovation. The barriers they identified include: fear of imitation, high costs of innovation, insufficient government support, lack of information, lack of qualified personnel, no market or insufficient knowledge about markets, and shortage of support and infrastructure (Neely, 1998: 6). In his research on program managers' management of innovation in major defense acquisition programs, Stinson identified the following barriers to innovation: inertia of the status quo, human tendencies to be risk-adverse, and the difficulty of achieving consensus for decision-making (Stinson, 2001: 64).

While these barriers may seem daunting, there is some good news. Research has shown that there are also enablers that promote innovation in today's market place. Neely identifies three elements that promote innovation in industry, they include: the availability of a skilled workforce, the presence of a strong technical infrastructure and strong public support for innovation (Neely, 1998: 6). Hammer and Champy also point out that the explosion in Information Technology is an essential enabler to dramatic changes within organizations (Hammer and Champy, 2001: 47). Another reason for hope

is the current focus on innovation by both public and private organizations, as shown by the dramatic increase in literature and interest on the subject.

Summary

This literature review covered the definitions of innovation, types of innovations, why both private and public organizations need to innovate to survive, and barriers and enablers to innovation in the market place today. The next chapter covers the results of the research accomplished in this effort.

III. Methodology

Introduction

This chapter describes the methods used to analyze the data in this research effort. The survey instrument and data are discussed followed by a description of multiple linear regression (MLR) and the content analysis procedures used in this thesis. This chapter concludes with a discussion on the known limitations of this type of research and a summary.

Data

The original intent of this research effort was to develop and field a survey instrument in order to obtain primary data on the factors that affect innovation within ASC. When this idea was presented**,** the researcher was dissuaded from surveying ASC personnel due to the concern that these personnel were already affected by survey fatigue. An alternate source of secondary archival data was offered to the researcher to perform this effort. This source was the 2002 Chief of Staff of the Air Force Organizational Climate Survey. In order to obtain this data for ASC organizations the researcher needed to obtain signed consent from each organizations commander/director. This effort was coordinated through the Wright-Patterson Air Force Base CSAF survey office. Once consent was received from the commanders/directors, the researcher and committee chairman then signed a Memorandum of Agreement with the ASC commander and the AFIT Commandant to ensure that the sensitive survey data was handled to ensure strict confidentiality and prevent unauthorized release.

All organizations were assured of their anonymity while participating in this research effort. To ensure anonymity the data from each organization was printed and all information identifying the organization was removed. The organizations' sanitized data packages were then randomly assigned a number from 1 to 23. This method assured that each organization could not be identified in the end product. Even the researcher has no knowledge of which number corresponds to which organization.

CSAF Survey Background

In the early 1990s most of the Major Commands (MAJCOM) in the Air Force implemented computer-based, census-type organizational climate surveys. In 1995 the Chief of Staff of the Air Force (CSAF) directed that a computer-based survey covering quality of life issues be made available to all USAF members. In 1997 the CSAF combined the quality of life survey with the organizational climate survey to reduce the number of surveys imposed on Air Force personnel. This combined survey was administered in 1997 and 1999 with quality of life issues reported to HQ USAF and the MAJCOMs and organizational climate results reported to the unit level. In February of 2001 the CSAF directed that the quality of life and organizational climate surveys again be separated and shortened in length. The 2002 survey was originally scheduled to be administered in October of 2001 but was delayed due to the September 11, 2001 bombing of the World Trade Center (CSAF Survey White Paper, 2002).

2002 CSAF Survey

This survey was administered from Jan. 22 to Mar. 8, 2002. It was made available to all active duty United States Air Force military and civilian members. More

than 279,000 personnel participated for a 65% response rate (AF News, 2002:1). The biennial survey was directed by the CSAF, its purpose was to provide actionable feedback on organizational climate issues to commanders at all levels. The stated goals for the implementation of the 2002 CSAF Organizational Climate Survey were to:

- Increase participation
- Increase utilization of the organizational climate survey
- Establish repeatable processes for future CSAF surveys

The survey was divided into the following 13 sections with each section containing several questions: the job, unit performance outcomes, teamwork, core values, job enhancement, supervision, training and development, participation/involvement, general satisfaction, leadership, unit flexibility, recognition, and unit resources. The questions were answered based on the following 6-point scale:

- 1 = Strongly Disagree
- 2 = Disagree
- 3 = Slightly Disagree
- 4 = Slightly Agree
- 5 = Agree
- 6 = Strongly Agree

The questions were all reviewed and approved by the CSAF prior to the surveys implementation. According to the CSAF survey white paper available on the survey's web site (csafsurvey.af.mil) the Air Force Manpower and Innovation Agency (AFMIA) was responsible for the survey and worked closely with the US Air Force Academy to ensure that the most reliable, valid questions were included and to ensure accurate statistical analysis of the data. All of the sections and questions are included in the appendix. The data was collected primarily via the Internet and all participants'

anonymity was ensured through the use of advanced information-masking software (CSAF Survey White Paper, 2002).

Population

The population for this research consisted of 24 participating ASC organizations. The following information on ASC was provided in the United States Air Force Fact Sheet for Wright-Patterson Air Force Base:

> Aeronautical Systems Center (ASC) is the host unit at Wright-Patterson and is the largest of four product centers in Air Force Materiel Command. ASC's mission: "Rapidly delivering war-winning capability". With an average annual budget of close to $13 billion, and it has a work force of about 9,000 civilians and military members at Wright-Patterson, ASC develops, acquires, modernizes and sustains the world's best aerospace systems. An additional 1,800 ASC personnel manage aircraft crew support programs at the 311th Human Systems Wing at Brooks Air Force Base, Texas.

The organizations were made up of a mix of Air Force officers, enlisted and DoD civilians. One organization was excluded from the study because there was missing data in its report due to its small size, making the final number of participating organizations 23 with approximately 8000 individuals within these organizations participating in the survey.

Method

The data from the 23 participating organizations was made available to the researcher in electronic form. The quantitative data consisted of the responses to the 61 questions included in appendix A. This data was input in JMP, version 5, a powerful statistical evaluation software package. JMP was chosen because the researcher was familiar with it and it is a very user-friendly software package. Once the data was input

10 observations were selected and the accuracy of the data input was verified by comparing the original data to the input data. No errors or abnormalities were found.

The questions that dealt with innovation were identified from the 61 questions quantitatively measured by the survey. The selected questions met the definition of innovation uncovered in the literature review. Once these questions were identified the JMP package was used to produce a multiple linear regression model that identified the survey questions that were most highly correlated to the questions identified as measuring innovation. The results were then used to form propositions about the factors that affect innovation within the participating organizations.

Linear Regression

Deterministic models are used when it is believed that there is an exact relationship between the dependent or response variable (y) and the independent, or predictor, variable (x). When it is expected that there will be unexplained variation in the model a probabilistic model is utilized that accounts for the random error (ε). The general form of a probabilistic model is (McClave, 2001:457):

y = deterministic component + random error

In simple linear regression there is only one predictor variable. Having only one predictor allows for a simple model but it rarely reflects real world situations. Most applications of linear regression utilize models that are more complex. When there is more than 1 predictor multiple linear regression (MLR) is used to incorporate the additional predictors (McClave, 2001: 534). MLR and Stepwise MLR were utilized to build statistical models for each identified question in this study.

Model Assumptions

In order to use linear regression to specify a model, four assumptions must be made about the general form of the probability distribution:

Assumption 1: the mean of the probability distribution of the error is 0.

Assumption 2: The variance of the probability distribution of the error is constant for all settings of the independent variable.

Assumption 3: The probability of the error distribution is normal.

Assumption 4: The values of the error are associated with any two observed values of y are independent.

According to McClave, et all:

> "When we apply regression analysis to a set of data, we never know for certain whether these assumptions are satisfied…we assume that the random error term has a normal probability distribution with mean equal to 0 and constant variance. Also, we assume that the random errors are probabilistically independent. It is unlikely that these assumptions are ever satisfied exactly in a practical application of regression analysis. Fortunately, experience has shown that least squares regression analysis produces reliable statistical tests, confidence intervals, and prediction intervals as long as the departures from the assumptions are not too great (McClave, 2001: 634).

Because the assumptions all concern the random error, the first step in testing these assumptions is to estimate the random error. The actual random error is the difference between the actual y value and the y value mean. Since we don't know the y value mean we must estimate it and take the difference. This is done for each observation with the results being the residuals that will be used to test the assumptions using residual analysis. Residuals can be calculated and plotted by hand but it is tedious so we allowed JMP to calculate and plot them for us (McClave, 2001: 635).

Assumption 1 will, by its very definition, always be satisfied when performing residual analysis. “The mean of the residuals is equal to zero. This property follows from the fact that the sum of the differences between the observed y values and their least squares predicted y values is equal to zero (McClave, 2001: 636).” Assumption 4 is not pertinent to this effort as it is only applicable when analyzing sequential or time series data (Neter, 2001: 26).

Assumption 3 was tested by plotting the residuals in a normal quantile plot within JMP and comparing them to known distributions.

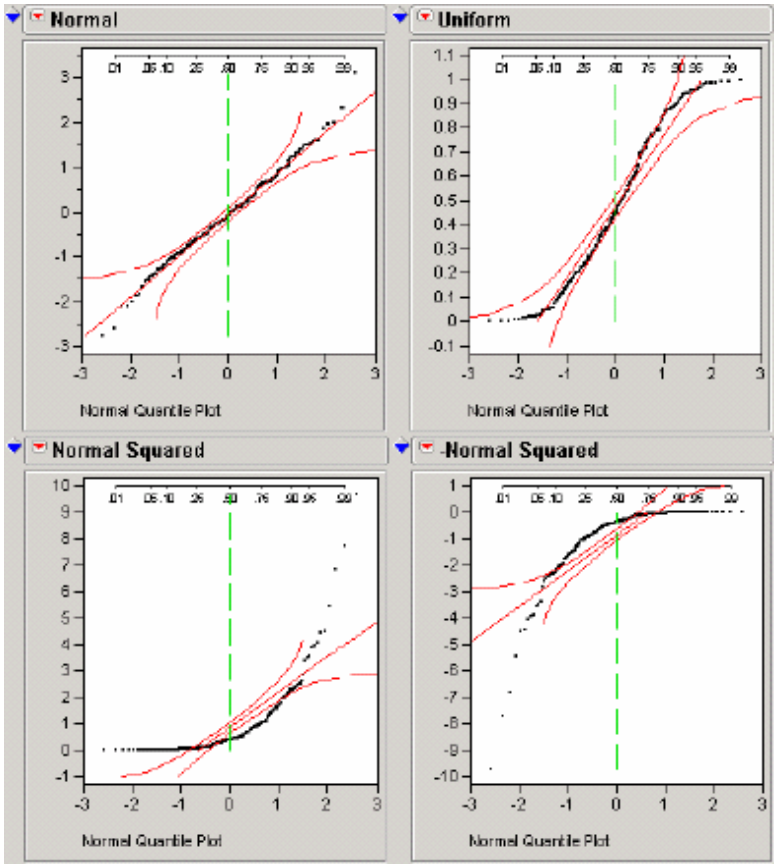

Figure 2: Distribution Examples

• The plot called Normal is the normal quantile plot for a normal distribution and appears as a diagonal linear pattern.

• The second example is for a uniform distribution, a flat distribution that produces an S-shaped quantile plot. A very peaked distribution produces an inverted S-shaped quantile plot (not shown).
• Squaring a normal distribution yields a new distribution that is skewed to the right. This produces the concave normal quantile plot that is labeled Normal Squared.
• A distribution that is skewed to the left produces the convex pattern similar to the one shown in the example labeled –Normal Squared. (JMP Help book, 40)

A normal quantile plot for a model can be assumed to have a normal distribution if all of the points lie within the red curved lines illustrated in Figure 2 and the data is in a roughly linear form.

Assumption 2 was tested by producing a residual by predicted plot. The residuals should be randomly scattered around the zero axis with approximately equal points above and below the axis in order to assume equality of variance (JMP Help book, 199). The results are shown in chapter 4.

Multicollinearity

Sometimes two or more independent variables are highly correlated and contribute redundant information to the model. According to McClave "When highly correlated independent variables are present in a regression model, the results are confusing. (McClave, 2001: 650)" This effect is known as multicollinearity and should be eliminated in order to obtain a useful model. The use of stepwise regression eliminates the inclusion of multicollinear independent variables in the final model by checking each variable against those already included in the model and excluding any highly correlated variables at each step (McClave, 2001: 651). The exclusion of one multicollinear variable at the expense of another does not imply that the excluded variable couldn't add value to the model on its own, stepwise regression just ensures that

the variable that adds the most explanatory power of the 2 is included. The absence of multicollinearity in the final model can be confirmed by checking the variance inflation factor (VIF) of each independent value. "The VIF for each term in the model measures the combined effect of the dependences among regressors on the variance of that term. One or more large VIFs indicate multicollinearity. Practical experience indicates that if any of the VIFs exceeds 5 or 10, it is an indication that the associated regression coefficients are poorly estimated because of multicollinearity." (Montgomery, 2001: 337) Each independent variable's VIF was checked using the JMP output to ensure the lack of multicollinearity in the final model. The results are shown in the next chapter.

Correlation

The results of this study show the correlation between the dependant and independent variables. According to Royce, "A correlation coefficient is a statistic that ranges between -1.00 and 1.00. In a perfect correlation, movement within one variable is matched by a corresponding movement in the other." (Royce, 1999: 244). JMP produces several statistics to measure correlation. The first is the Pearson product moment coefficient of correlation, represented by *r*, this statistic measures the strength of the linear relationship between the x and y variables. "A value of *r* near or equal to zero implies little or no relationship between y and x. In contrast the closer r comes to 1 or -1, the stronger the linear relationship between y and x." (McClave, 2001: 490) A positive value of *r* shows a positive linear relationship between the variables and a negative value implies a negative relationship. A positive *r* means that as x increases so does y; a negative *r* means that as x decreases y also decreases (McClave, 2001: 490).

Another statistic used to measure the contribution of x in predicting y is the coefficient of determination or *r square*. The coefficient of determination, *r square,* is simply the Pearson product moment coefficient of correlation, *r,* squared. Since *r* is always between 1 and -1, *r square* is always between 0 and 1. A *r square* of 1 implies that the strait-line model being measured can explain 100% of the variation in y. A high *r square* tells us that the x values chosen in the final model have a high explanatory power in regards to y. Caution must be used when relying solely on *r square* to examine the explanatory power of the model. According to McClave;

> ...*r square* is a sample statistic that tells us how well the model fits the data and thereby represents a measure of the usefulness of the entire model. A large value of *r square* computed from the sample data does not necessarily mean that the model provides a good fit to all the data points in the population. For example, a first order linear model that contains three parameters will provide a perfect fit to a sample of 3 data points and *r square* will equal 1. Likewise, you will always obtain a perfect fit (*r square* = 1) to a set of n data points if the model contains exactly n parameters. Consequently if you want to use *r square* as a measure of how useful the model will be for predicting y, it should be based on a sample that contains substantially more data points than the number of parameters in the model. (McClave, 2001: 556)

In other words, if you have more predictors than observations your *r square* will always equal 1 and the model will have no practical value.

Since the data set used in this research contains 23 observations and 61 predictors, *r square* was not a valid statistic in this case. The adjusted multiple coefficient of determination, *r square adjusted,* adjusts for the sample size and the number of predictors. "*r square adjusted* will always be smaller than *r square* , and more importantly, cannot be "forced" to 1 by simply adding more and more independent variables to the model. Consequently, analysts prefer the more conservative *r square adjusted* when choosing a measure of model adequacy." (McClave, 2001: 557) The

adjusted multiple coefficient of determination, *r square adjusted,* was used to measure the fit of the model in this research. By using this statistic it allowed the researcher to develop manageable models containing only the factors that contribute the most to the explanatory power of the final product.

According to Montgomery, et al, a regression model does not imply a cause-effect relationship between the variables.

> Even though a strong empirical relationship may exist between two or more variables, this cannot be considered evidence that the regressor variables and the response are related in a cause-effect manner. To establish causality, the relationship between the regressors and the response must have a basis outside the sample data. Regression analysis can aid in confirming a cause-effect relationship, but it cannot be the sole basis of such a claim. (Montgomery, 2001: 6)

It is important to reiterate here that this effort was an inductive study whose purpose was to present propositions about the factors that influence innovation within Air Force units. The models presented in the following chapter were used to produce propositions in an area of research that had none. These propositions can then be tested in later research to see if there is evidence to support them.

Selected Questions

The following four questions were identified from the CSAF Organizational Climate Survey as being measures of innovation.

> 11.) In my unit, people make innovative suggestions for improvement.
> 35.) I feel free to suggest new and better ways of doing things.
> 55.) My unit encourages appropriate risk taking.
> 56.) My unit challenges old ways of doing business.

Question 11 was an obvious choice as it asks directly about innovation. Questions 35 and 56 were selected because they follow the definitions uncovered in the literature review

that innovations are new ways of doing things. Question 55 was selected because the top leaders throughout the Air Force almost always view innovation and risk taking as being highly related as shown by the quotes in chapter 1 and 2.

Content Analysis

A secondary purpose of this study was to do a content analysis on the comments section of the CSAF Survey in order to get a snapshot of ASC personnel's opinions on innovation in their organizations when the survey was conducted. The survey allowed for open-ended responses by using the following statements at the end of the survey questions.

List ONE thing that is good/going well in your organization.

List ONE thing that needs improvement in your organization.

This area is for general comments.

These comments were collected from all of the participating organizations and then rolled into one document for all of ASC. When the comments were transferred to a Microsoft Word document they filled 1187 pages. A content analysis was performed on this document and then trends were found in the results. According to Royce:

> Content analysis is another unobtrusive research process that objectively examines the content of communications. This objectivity is made possible by reliance upon quantification. Accordingly, content analysis involves searching for and counting key words, phrases or concepts in communications. These may be counted (frequencies of occurrence), measured (for example, the size of a newspaper article in column inches or the amount of time allocated to a specific topic in a speech), or otherwise categorized in a manner that others could replicate. (Royce, 1999: 211)

For this effort, key words were identified, counted and then categorized. To isolate the keywords in such a large document, the 'Find' function in Microsoft Word was

employed. This function allows the user to type in a key word or phrase and search an entire document. The 'find' function goes directly to each instance of the keyword contained in the document. Each comment containing a keyword was then cut and pasted to a new document. After this search was completed for each key word the findings were categorized according to their content as positive, negative, or neutral/not applicable. Once the findings were categorized, trends were sought within the positive and negative categories for each key word/phrase. The key words that were analyzed were innovation, idea, suggestion and risk taking. The results can be found in the following chapter.

Primary vs. Secondary Data

Traditionally, social scientists have been expected and encouraged to collect their own data so that their instrument of choice could be developed to elicit precisely the data that are needed for each particular study (Kiecolt, 1985: 9). As primary data collection becomes more costly and time consuming, researchers have been turning more and more to archival or secondary data analysis. In "Secondary Analysis of Data", Kiecolt and Nathan state:

> "Unfortunately, independent data collection by the individual investigator has become increasingly difficult. Constraints of the current economic climate and declining resources for research in the social sciences have made it necessary for more researchers to rely on existing survey data. The potential for accomplishing original research with precollected data is nonetheless tremendous. Secondary Analysis is thus gaining a central role in contemporary social research. It differs from primary research in that primary analysis involves both data collection and analysis, while secondary analysis requires the application of creative analytical techniques to data that have been amassed by others." (Kiecolt, 1985: 10)

David Royce in "Research Methods in Social Work" describes this type of research as "unobtrusive research called archival research or secondary data analysis" (Royce, 1999:

201). According to Royce secondary data analysis results in knowledge, interpretations and conclusions beyond those stated in the original study.(Royce, 1999: 201).

Advantages of Secondary Data Analysis

There are both advantages and disadvantages to using archival data in a research effort. The primary advantage is the savings in time and effort in the data collection phase. Since the data has already been collected the costs only include obtaining the data, preparing the data for analysis, and conducting the analysis. (Kiecolt, 1985: 53, Royce, 1999: 203-204). A second advantage is that using secondary analysis avoids data collection problems (Kiecolt, 1985: 10). Another advantage is that any bias associated with the collection of data is usually known and accepted when using archival data (Royce, 1999: 204). Another advantage is that since there is no interaction with the subjects the researcher is assured that the subjects of the study aren't at risk and the researcher may not need permission from review boards or other research committees to perform the research. According to Royce, "The final but best reason for conducting secondary analysis is that it provides an opportunity to study social problems in terms of long-term change and enables comparative study."(Royce, 1999: 204).

Disadvantages of Secondary Data Analysis

One of the major problems of using archival data to perform secondary data analysis is data availability. Sometimes it is difficult to find and/or obtain archival data that fits the researchers study. There can be many reasons for this including loss of data due to natural causes (fire, flood), mismatch of primary and secondary research objectives, and reluctance of primary researchers to share their data (Kiecolt, 1985: 12-

13, Royce, 1999: 204-205). Another disadvantage is that errors made in the original survey are not visible to the secondary researcher. If the original data contains errors, they can be magnified when the data is used for other than its original intent (Kiecolt, 1985: 13). Another disadvantage is that the use of secondary data may hinder creativity. If many researchers continue using the same secondary data it may limit the scope of research in that area (Kiecolt, 1985: 14). Earl Babbie (Babbie, 1998: 275) highlights another disadvantage of using secondary data when he states that,

> The key problem involves the recurrent question of validity. When one researcher collects data for one particular purpose, you have no assurance that those data will be appropriate for your research interests. Typically, you'll find that the original researcher asked a question that "comes close" to measuring what you're interested in, but you'll wish the question had been asked just a little differently--or that another, related question had also been asked. Your question, then, is whether the question that was asked provides a valid measure of the variable you want to analyze.

Despite these possible shortcomings Kiecolt and Nathan state that the advantages of using secondary data far outweigh the disadvantages (Kiecolt, 1985: 12). Hyman states that, “Secondary analysis is extremely versatile in that it can be applied to studies designed to understand the present or the past, to understand change, to examine phenomena comparatively, or to replicate and/or extend previous studies. (Hyman, 2001: 11-24).

Limitations

The main limitations of this study were the use of secondary data rather than primary data and the small sample size of the data being used. The advantages and disadvantages of secondary versus primary data have already been discussed. The small sample size used in this research is a direct result of the use of secondary data. Although

the data used included thousands of participants, the sample size was only 23 because the data was only available in a cumulative version for each of the 23 participating organizations. The ability to create and administer a primary survey or the availability of individual responses from the secondary data source would have increased the sample size and alleviated this liability. The only limitation noted with the content analysis portion of the study was the lack of insight into the number of people that actually made comments. The comments were only available in their cumulative form from each organization. The number of comments made is known but the actual number of people that took the time to write the comments is unknown.

Summary

The preceding chapter covered the methodology used in this thesis effort. The data used came from the 2002 Chief of Staff of the Air Force Organizational Climate Survey. This survey was discussed, to include the history of the survey instrument, the current survey, and the population that was sampled. Next, the methods used to complete the survey were discussed. Multiple linear regression and content analysis procedures were used to complete this study. The chapter concluded with a discussion on the pros and cons of using secondary data for social research and the limitations of this effort.

IV. Results

Introduction

This chapter discusses the results of the study. The first MLR model is described in detail. The following models rely on the same procedures as the first; therefore the results will only be presented for each subsequent model. The results of the content analysis are also included.

Question 11 Models

The first model run was performed on question 11 from the CSAF Organizational Climate Survey, "In my unit, people make innovative suggestions for improvement." A mixed stepwise regression was run in JMP with question 11 identified as the dependent (y) variable and all other questions identified as independent variables (x). Stepwise regression adds each independent variable to the model one at a time and removes redundant predictors until the best model remains. An example of the stepwise output for question 11 is provided below.

Table 1: Question 11 Step History

Step History

Step	Parameter	Action	"Sig Prob"	Seq SS	RSquare	Cp	p
1	Question 2	Entered	0.0000	245.8628	0.5876	.	2
2	Question 10	Entered	0.0004	80.81438	0.7807	.	3
3	Question 25	Entered	0.0082	28.869	0.8497	.	4
4	Question 24	Entered	0.0270	15.32555	0.8863	.	5
5	Question 17	Entered	0.0466	10.13498	0.9106	.	6
6	Question 23	Entered	0.0552	7.893785	0.9294	.	7
7	Question 25	Removed	0.7009	0.282344	0.9287	.	6
8	Question 43	Entered	0.0256	8.186088	0.9483	.	7
9	Question 41	Entered	0.0907	3.869682	0.9576	.	8
10	Question 55	Entered	0.0126	6.544871	0.9732	.	9
11	Question 17	Removed	0.9250	0.007361	0.9732	.	8
12	Question 12	Entered	0.0380	3.059764	0.9805	.	9
13	Question 32	Entered	0.0150	3.071165	0.9878	.	10
14	Question 37	Entered	0.0349	1.630951	0.9917	.	11
15	Question 56	Entered	0.0259	1.300979	0.9948	.	12
16	Question 53	Entered	0.0708	0.626904	0.9963	.	13
17	Question 52	Entered	0.2041	0.264448	0.9970	.	14
18	Question 33	Entered	0.1213	0.34639	0.9978	.	15
19	Question 53	Removed	0.3313	0.123371	0.9975	.	14
20	Question 20	Entered	0.0789	0.35176	0.9983	.	15
21	Question 17	Entered	0.0268	0.365919	0.9992	.	16
22	Question 4	Entered	0.0476	0.16647	0.9996	.	17
23	Question 19	Entered	0.0563	0.089145	0.9998	.	18
24	Question 6	Entered	0.0129	0.059742	1.0000	.	19
25	Question 59	Entered	0.0080	0.012164	1.0000	.	20
26	Question 54	Entered	0.0302	0.000862	1.0000	.	21
27	Question 48	Entered	0.0003	0.000055	1.0000	.	22

Once these results were available the researcher was then able to choose the top independent variables that contribute the most to *r square*, as identified by the stepwise output, and run a model in JMP. To run the model in JMP, question 11 was again identified as the dependant variable, the questions identified by the step wise regression were identified as the independent variables and a standard least squares model was produced by JMP. After the model was produced, the assumptions mentioned in the previous chapter were checked by utilizing the JMP software package.

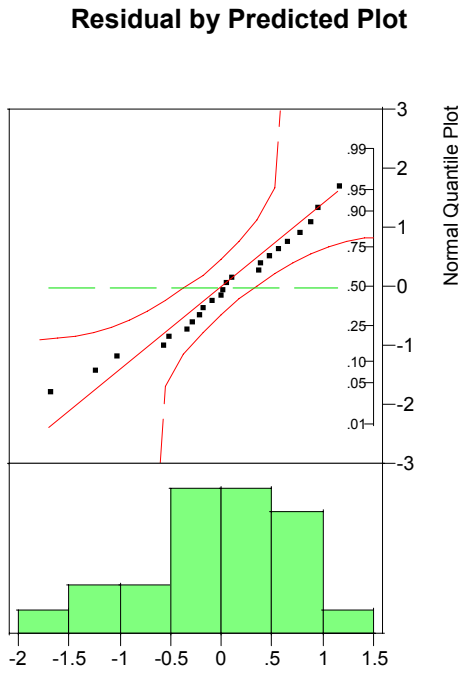

Figure 3: Q11, First Model Normality Check

First the assumption of normality had to be checked. This was accomplished by saving the residuals and then producing a normal quantile plot in JMP. The results are shown in figure 3. Normality for this model can be assumed because all data points lie within the bounds and the data approximates a line.

Next the assumption of equality of variance was checked.

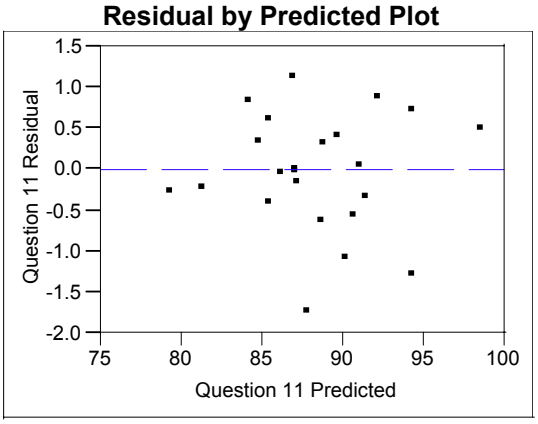

Figure 4: Q11, First Model Equality of Variance Check

Equality of variance can be assumed because the residuals are randomly scattered with approximately equal points to both sides of the zero axis.

Once the assumptions were checked, the *r square* adjusted was checked and the model was checked for multicollinearity.

Table 2: Q11, First Model Summary of Fit

Summary of Fit

RSquare	0.973178
RSquare Adj	0.960661
Root Mean Square Error	0.864999
Mean of Response	88.26087
Observations (or Sum Wgts)	23

Table 3: Q11, First Model, Parameter Estimates

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Std Beta	VIF
Intercept	-53.85853	9.003551	-5.98	<.0001	0	.
Question 2	0.9797054	0.071682	13.67	<.0001	0.851266	2.16946
Question 10	0.8350631	0.079442	10.51	<.0001	0.675634	2.3103502
Question 24	0.4542385	0.064938	6.99	<.0001	0.436229	2.1749742
Question 55	-0.286305	0.064749	-4.42	0.0005	-0.36106	3.7287617
Question 23	-0.506217	0.081573	-6.21	<.0001	-0.49111	3.5023831
Question 43	-0.320766	0.078491	-4.09	0.0010	-0.68446	15.687481
Question 41	0.4067451	0.085399	4.76	0.0003	0.813385	16.309731

The *r square adjust* for this model was .96. This means that the model explained 96% of the variability of the dependent variable. When the multicollinearity was checked it was discovered that the last 2 independent variables had VIF values over 10. Values over 10 indicate multicollinearity so these variables were dropped from the model.

Question 11 - Model 2

Once the 2 variables that displayed multicollinearity were dropped the model was re-run with the remaining variables. The same process was followed to check the new model. The results are shown below.

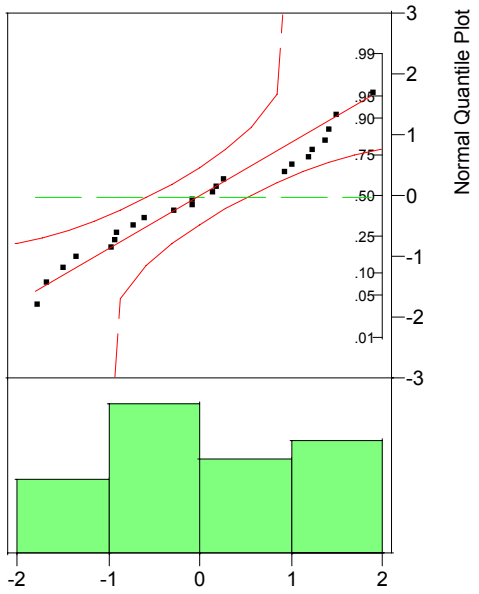

Figure 5: Q11, Second Model Normality Check

Normality was again checked for the new model. The residuals without the 2 deleted variables appeared to be slightly less normally distributed than the original model but still approximated normality enough to satisfy the assumption.

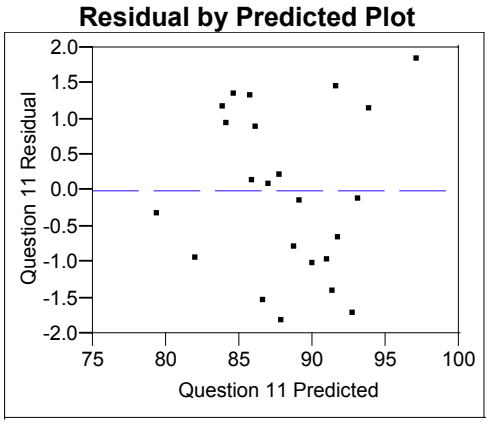

Figure 6: Q11, Second Model Equality of Variance Check

Next, equality of variance was checked for the new model. The residuals are still randomly scattered about the zero axis so this assumption was also satisfied.

Table 4: Q11, Second Model Summary of Fit

Summary of Fit

RSquare	0.932603
RSquare Adj	0.912781
Root Mean Square Error	1.287977
Mean of Response	88.26087
Observations (or Sum Wgts)	23

Table 5: Q11, Second Model Parameter Estimates

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	VIF
Intercept	-50.17719	10.46882	-4.79	0.0002	.
Question 2	0.9740037	0.102344	9.52	<.0001	1.9946752
Question 10	0.7700562	0.114084	6.75	<.0001	2.1490587
Question 24	0.3880927	0.084748	4.58	0.0003	1.6708393
Question 55	-0.180764	0.060257	-3.00	0.0081	1.4565913
Question 23	-0.434984	0.119242	-3.65	0.0020	3.3755378

The new model produced an RSquare Adj of .91. This model only lost .05 from the RSquare Adj of the original model by deleting the 2 multicollinear variables. All of the VIFs in this model were significantly lower than 10, indicating that multicollinearity was not a concern with this model for question 11.

The next step to ensure that the best model was used was to check each independent variable against the dependent variable to see the strength of each variable on its own and ensure that the model with the most explanation power while using the fewest variables was selected as the final model.

Table 6: Question 2 Summary of Fit

Summary of Fit

RSquare	0.587577
RSquare Adj	0.567938
Root Mean Square Error	2.866655
Mean of Response	88.26087
Observations (or Sum Wgts)	23

Table 7: Question 2 Parameter Estimates

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	VIF
Intercept	5.1431324	15.20752	0.34	0.7386	.
Question 2	0.882191	0.161284	5.47	<.0001	1

Question 2 was the first independent variable checked against the dependent variable. By itself it had an RSquare adjust of .57

Table 8: Question 10 Summary of Fit

Summary of Fit

RSquare	0.561546
RSquare Adj	0.540668
Root Mean Square Error	2.955739
Mean of Response	88.26087
Observations (or Sum Wgts)	23

Table 9: Question 10 Parameter Estimates

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	VIF
Intercept	6.5547619	15.76689	0.42	0.6818	.
Question 10	0.9261905	0.178591	5.19	<.0001	1

Question 10 was then checked; it had an RSquare adjust of .54.

Table 10: Question 23 Summary of Fit

Summary of Fit

RSquare	0.241468
RSquare Adj	0.205347
Root Mean Square Error	3.887687
Mean of Response	88.26087
Observations (or Sum Wgts)	23

Table 11: Question 23 Parameter Estimates

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	VIF
Intercept	42.124089	17.86253	2.36	0.0281	.
Question 23	0.5065136	0.195902	2.59	0.0173	1

Question 23 was checked next; its RSquare adjust was .21.

Table 12: Question 24 Summary of Fit

Summary of Fit

RSquare	0.018941
RSquare Adj	-0.02778
Root Mean Square Error	4.421319
Mean of Response	88.26087
Observations (or Sum Wgts)	23

Table 13: Question 24 Parameter Estimates

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	VIF
Intercept	75.967553	19.32862	3.93	0.0008	.
Question 24	0.1433078	0.225065	0.64	0.5312	1

The first problem was encountered when question 24 was checked against question 11. This variable, on its own, explains almost none of the variation around the dependent variable as witnessed by its RSquare of .02 and RSquare adjust of -.03.

Table 14: Question 55 Summary of Fit

Summary of Fit

RSquare	0.01396
RSquare Adj	-0.03299
Root Mean Square Error	4.432529
Mean of Response	88.26087
Observations (or Sum Wgts)	23

Table 15: Question 55 Parameter Estimates

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	VIF
Intercept	80.521364	14.22424	5.66	<.0001	.
Question 55	0.0936887	0.171824	0.55	0.5913	1

Question 55 was even less significant than 24. It had an RSquare of .01 and an RSquare adjust of -.03.

The individual RSquare adjust data shows that questions 2 and 10 explained the most variance. It appears that question 23 is still significant and adds value to the model but questions 24 and 55 are not very helpful on their own. They do seem to have some synergistic effects when combined with the other three dependent variables but in the interest of parsimony, and to avoid over fitting the model, it was decided to delete 24 and 55 from the final model. Parsimony is defined as "using the simplest model that is consistent with the data and knowledge of the problem environment." (Montgomery, 2001: 223)

Question 11 - Final Model

The final model including questions 2, 10, and 23 was then checked to ensure that it still met all of the assumptions explained in chapter 3.

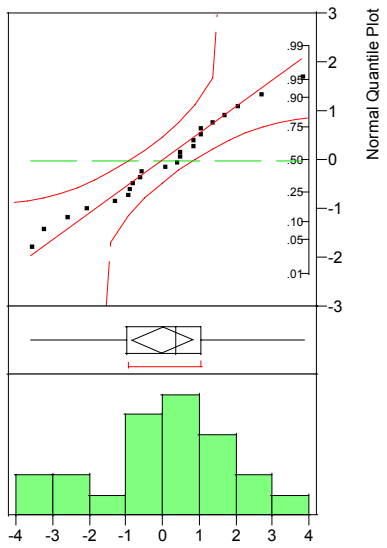

Figure 7: Q11, Final Model Normality Check

Normality of the data was verified for the final model. Figure 7 showed that the final model was the most normally distributed of the three models produced and that the assumption of normality was correct for this model.

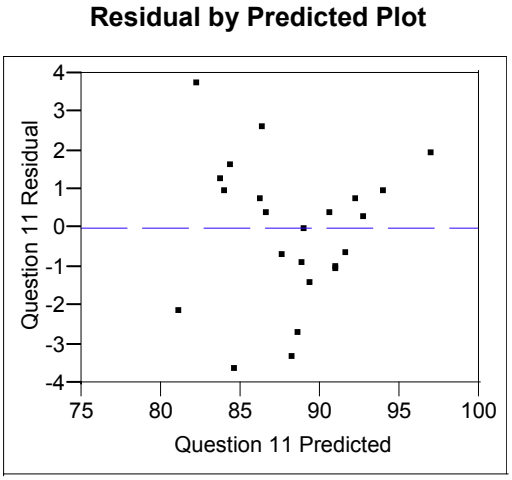

Figure 8: Q11, Final Model Equality of Variance Check

Next, equality of variance was checked for the final model. The residuals are still randomly scattered about the zero axis so this assumption was also satisfied.

Table 16: Q11, Final Model Summary of Fit

Summary of Fit

RSquare	0.822891
RSquare Adj	0.794926
Root Mean Square Error	1.974958
Mean of Response	88.26087
Observations (or Sum Wgts)	23

Table 17: Q11, Final Model Parameter Estimates

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Std Beta	VIF
Intercept	-22.76201	12.25065	-1.86	0.0787	0	.
Question 2	0.6934971	0.131855	5.26	<.0001	0.60258	1.4081395
Question 10	0.8430493	0.172333	4.89	0.0001	0.682096	2.085619
Question 23	-0.314954	0.148063	-2.13	0.0467	-0.30555	2.2135133

The results of the final model for question 11 indicate that questions 2, 10, 23 have an *r square adjust* of .795. This means that this model explains 79.5% of the variance for question 11. Each variable was then checked to determine its contribution to the final *r square adjust*.

Variables Included in the Final Model

The standard beta (Std Beta) score in the JMP output can be used to rank the strength of each independent variable in the final model. The numeric output shows the strength regardless of the positive or negative sign. The signs show whether the independent variable positively affects the dependent variable or negatively affects the dependent variable. For example a positive value means that if all other variables remained the same and there was one unit of change in the independent variable in question, it would have a positive affect on the dependent variable. The opposite is true for a negative value.

From looking at table 17, it can be seen that question 10 was the strongest indicator and it had a positive impact on question 11. Question 10 was, "In my unit, people help each other out when they have heavy workloads."

Question 2 was the next strongest indicator and also had a positive correlation with question 11. Question 2 is, "The quantity of work accomplished in my unit is high."

The weakest indicator of the three independent variables was question 23, which was negatively correlated to question 11. Question 23 was, "I am encouraged by unit leadership to learn new things."

The step-by-step procedure for question 11 was included to show the entire process involved for selection of a final model that has the most explanatory power with the fewest variables. The same process was followed for all of the models in this research effort. For the remaining independent variables only the final models will be shown.

Question 35 Model

The next question identified as a dependent variable that measures innovation was question 35, "I feel free to suggest new and better ways of doing things." The results and check of assumptions from following the same procedures that were used for question 11 are shown below.

Table 18: Q35, Summary of Fit

Summary of Fit

RSquare	0.814959
RSquare Adj	0.773839
Root Mean Square Error	1.753844
Mean of Response	90.65217
Observations (or Sum Wgts)	23

Table 19: Q35, Parameter Estimates

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Std Beta	VIF
Intercept	16.37236	15.79764	1.04	0.3137	0	.
Question 38	0.6836054	0.104365	6.55	<.0001	1.018348	2.3512109
Question 30	-0.385437	0.157625	-2.45	0.0250	-0.40038	2.6079246
Question 5	0.507289	0.203477	2.49	0.0226	0.357297	1.9979497
Question 39	0.0590134	0.094476	0.62	0.5400	0.093706	2.1891726

The final model included 4 independent variables with an RSquare adjust of .77. The 4 independent variables were questions 38, 30, 5, and 39. All of the VIFs are substantially lower than 10 indicating that multicollinearity is not a concern. The assumptions were then verified for this model.

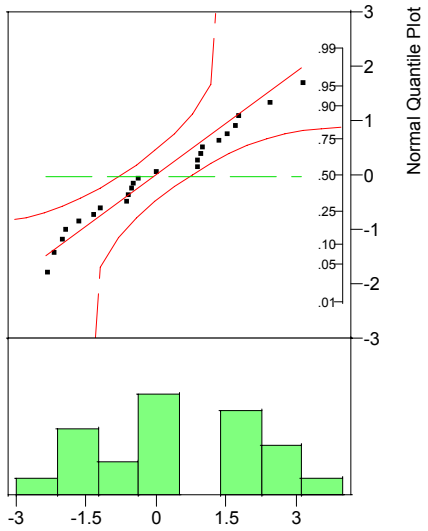

Figure 9: Q35, Normality Check

The residual plot shows that this model approximates a normal distribution and that this assumption is satisfied.

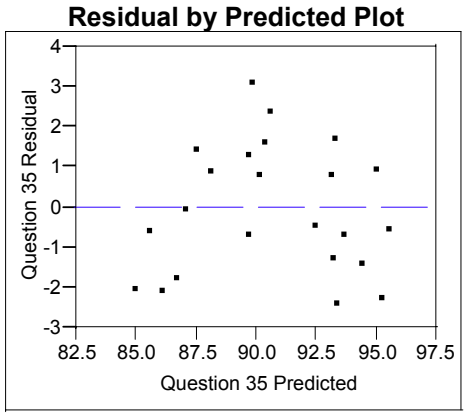

Figure 10: Q35, Equality of Variance Check

The residual by predicted plot showed that the equality of variance assumption was also satisfied as the data points are randomly scattered about the zero axis.

The questions were then rank ordered by comparing their Std Beta scores. The results follow.

Question 38 was by far the strongest indicator with a Std Beta score of 1.02. It had a positive impact on question 35. Question 38 was, "Suggestions made by unit personnel are implemented in our daily work activities."

Question 30 was the next strongest indicator and was negatively correlated to question 35. Question 30 was, "My supervisor looks out for the best interest of my work group."

Question 5 was the next strongest indicator and it was positively correlated to the independent variable. Question 5 was, "My job requires me to use a variety of skills."

Question 39 was the weakest indicator of the 4 included in the final model. Question 39 was, "The leaders in my chain of command (in my unit) listen to my ideas."

Question 55 Model

The next question identified as a dependent variable that measures innovation was question 55, "My unit encourages appropriate risk taking." The results and check of assumptions are shown below.

Table 20: Q55, Summary of Fit

Summary of Fit

RSquare	0.83477
RSquare Adj	0.818247
Root Mean Square Error	2.344751
Mean of Response	82.6087
Observations (or Sum Wgts)	23

Table 21: Q55, Parameter Estimates

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Std Beta	VIF
Intercept	2.2074386	8.038645	0.27	0.7864	0	.
Question 57	0.6124386	0.126725	4.83	0.0001	0.611678	1.9390433
Question 39	0.3526341	0.118872	2.97	0.0076	0.375464	1.9390433

The final model included two independent variables with an *r square adjust* of .82. The two dependent variables were questions 57 and 39. The VIFs are both below 10, indicating that multicollinearity is not a concern. The assumptions were then verified for this model.

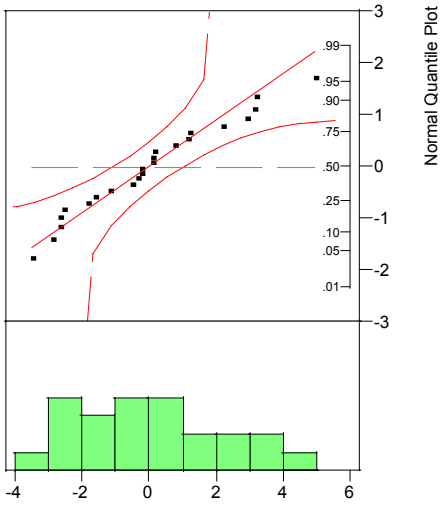

Figure 11: Q55, Normality Check

The residual plot shows that this model approximates a normal distribution and that this assumption is satisfied.

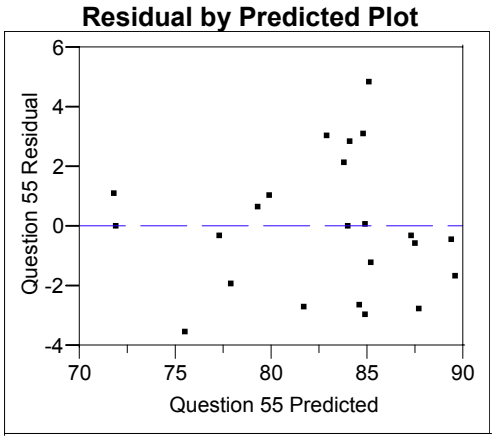

Figure 12: Q55 Equality of Variance Check

The residual by predicted plot showed that the equality of variance assumption was also satisfied as the data points are randomly scattered about the zero axis.

For this model, question 57 is the strongest indicator and positively correlated to the independent variable. Question 57 is, "My unit adapts to changes well." Question 39 is also a strong indicator and is positively correlated. Question 39 is, "The leaders in my chain of command (in my unit) listen to my ideas."

Question 56 Model

The final question identified as a dependent variable that measures innovation was question 56, "My unit challenges old ways of doing business." The results and check of assumptions are shown below.

Table 22: Q55, Summary of Fit

Summary of Fit

RSquare	0.901902
RSquare Adj	0.880103
Root Mean Square Error	1.900297
Mean of Response	80.86957
Observations (or Sum Wgts)	23

Table 23: Q55, Parameter Estimates

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Std Beta	VIF
Intercept	5.0129692	7.799096	0.64	0.5285	0	.
Question 57	0.6002041	0.131388	4.57	0.0002	0.600755	3.1733772
Question 41	0.2921415	0.076879	3.80	0.0013	0.46425	2.7387256
Question 48	-0.268248	0.083773	-3.20	0.0049	-0.33182	1.9704444
Question 52	0.263884	0.099972	2.64	0.0167	0.235405	1.4593905

The final model included four independent variables with an *r square adjust* of .88. The four independent variables were questions 57, 41, 48, and 52. The VIFs are all lower than 10, indicating that multicollinearity is not a concern. The assumptions were then verified for this model.

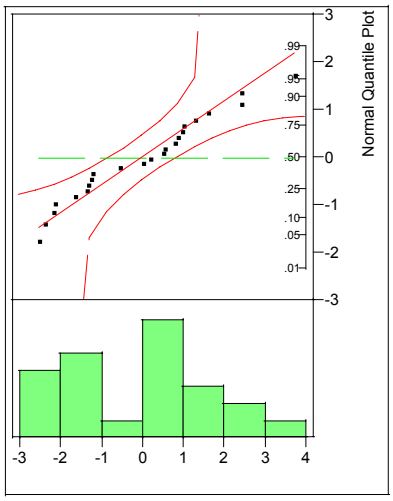

Figure 13: Q56, Normality Check

The residual plot shows that this model approximates a normal distribution and that this assumption is satisfied.

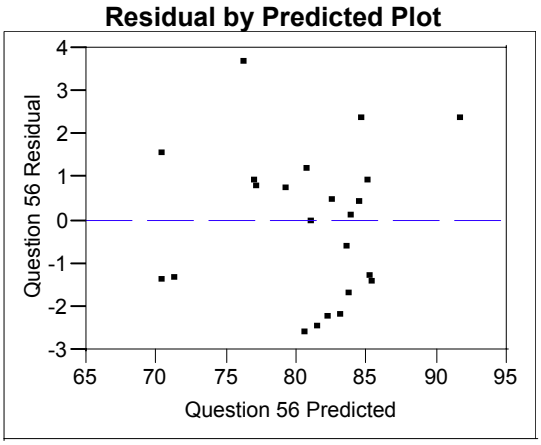

Figure 14: Q56, Equality of Variance Check

The residual by predicted plot showed that the equality of variance assumption was also satisfied as the data points are randomly scattered about the zero axis.

For this model, question 57 is again the strongest indicator and positively correlated to the independent variable. Question 57 is, "My unit adapts to changes well."

Question 41 is the next strongest indicator and is positively correlated. Question 41 is, "I trust the leaders in my chain of command (in my unit)." Question 48 is the next strongest indicator and is negatively associated to the independent variable. Question 48 states, "I would recommend an assignment in my unit to a friend."

Question 52 is the weakest indicator of the four. Question 52 states, "I have the right tools/equipment to accomplish my job."

Content Analysis Results

A content analysis was conducted on each of the following key words/phrases: innovation, idea, suggestion, and risk taking. The search for risk taking did not turn up any significant trends, the results for the other three key words are included below.

Once the comments were isolated they were then categorized into positive, negative or neutral/not applicable categories. A positive comment was one that showed

support for the key word in regards to innovation. An example of a positive comment would be, "New ideas are sought after and supported in my organization." A negative comment would be the opposite, such as, "I feel that my ideas are completely ignored in my unit." A neutral or not applicable comment is one that neither shows positive or negative traits or one that has nothing to do with innovation. A not applicable comment was usually found when the key word was used in a different way than the researcher was looking for. An example of this type of comment is, "I have no idea what my supervisor was thinking." This comment would be identified under the search for the key word "idea" but it has neither a positive or negative connotation as to whether ideas are supported within an organization. Once all of the comments were coded, trends were then found within both the positive and negative responses for each key word. The results follow.

Content Analysis: Key Word = Innovation

The first keyword that was analyzed was "innovation". The search of the document turned up 28 comments that used the term innovation or a variation of this word. Of the identified instances, 14 were categorized as negative, 13 as positive and one as neutral. Within the negative responses there was only one significant trend identified. Five of the fourteen responses indicated that the respondents believed that there was no management support for innovation or innovative ideas.

Of the 13 positive responses there was also only one significant trend identified and it directly opposed the trend found within the negative responses. Six of the 13

positive respondents indicated that they felt that innovation was supported and encouraged within their organization.

Content Analysis: Key Word = Idea

The next keyword that was analyzed was "idea". There were 229 responses that contained the word idea in them. Of the responses, 96 were coded neutral or not applicable, 88 negative and 45 positive. There were seven trends identified within the negative responses. The most significant trend had 22 comments that stated that the respondents believed that their ideas were ignored within their organizations. The next most significant trend came with 12 responses that felt that they were either never asked for their ideas or that there was no forum available within their organizations in which to share ideas. The next trend had 10 responses that indicated that ideas were sought in their organization but never implemented. The next three trends all had seven responses. The first trend with seven responses indicated that people felt that ideas were only implemented within their units if they were directed from the top down. Another trend with seven responses indicated that people felt that there was favoritism within their organization and that only the ideas from management's "favorites" were paid attention to. The final trend with seven responses was that ideas were ignored or not implemented within their organizations because the organization's culture was resistant to change. The last negative trend identified had five responses and indicated that these respondents felt that they were too busy or didn't have enough time to look for new ideas.

There were two trends noted within the positive responses for the keyword "idea". The most significant trend, with an overwhelming 37 of 45 responses was the feeling that

people felt supported and encouraged to share their ideas within their organization. The other trend had four responses and indicated that the respondents felt that bringing new people into the organization brought new perspectives and ideas.

Content Analysis: Key Word = Suggestion

The next key word analyzed was "suggestion". This word was identified for analysis because in many peoples vocabulary it is interchangeable with "idea". The search found 82 occurrences of "suggestion" with in the document. Of the 82, 60 were either neutral or not applicable, 15 were negative and seven were positive. There was only one trend uncovered in both the negative and positive strings. Within the negative responses 12 people felt that their suggestions were not supported or listened to. All seven of the positive responses indicated that the respondents felt that their suggestions were supported and encouraged in their organizations.

V. Conclusions and Recommendations

Introduction

The purpose of this research effort was to identify factors identifying innovation within the participating ASC organizations by using multiple linear regression on the quantitative portion of the CSAF survey, and to identify perceived barriers and enablers to innovation by performing content analysis on the qualitative responses to the CSAF survey's open ended questions. This chapter addresses the conclusions and recommendations that resulted from this effort.

MLR Question 11 Model Conclusions

The final model for question 11, "In my unit, people make innovative suggestions for improvement", included three predictors that explain 79.5% of the variability in question eleven's responses. The three predictors, in order of strength, were questions 10, 2 and 23.

Question 10, "In my unit, people help each other out when they have heavy work loads" and question 2, "The quantity of work accomplished in my unit is high", were the strongest predictors and had a positive relationship with question 11. From this finding the following proposition is presented:

P1: Organizations with heavy workloads and good teamwork are more innovative.

Question 23, "I am encouraged by leadership to learn new things", was the weakest predictor and was negatively related to the dependent variable. From this information it could be proposed that organizations that encourage their employees to learn new things are less innovative. This finding seems counterintuitive; one would

expect an organization that encourages its employees to learn new things would be more innovative than one that does not. This finding is troubling, however the first two predictors were each more than twice as strong as the third. This information is included because it was an actual result of the study. However, because this proposition is formed using the weakest indicator and because it doesn't seem to make sense, it is questionable. This finding may be explained by the explanation given by Montgomery, et al:

> When using multiple regression, occasionally we find an apparent contradiction of intuition or theory when one or more of the regression coefficients seems to have the wrong sign. For example, the problem situation may imply that a particular regression coefficient should be positive, while the actual estimate of the parameter is negative. This "wrong" sign problem can be disconcerting, as it is usually difficult to explain a negative estimate of a parameter to a model user when that user believes that the coefficient should be positive. (Montgomery, 2001: 120)

They go on to point out that there are four reasons that a regressor may have the wrong sign. They are:

1. The range of some of the regressors is too small.
2. Important regressors have not been included in the model.
3. Multicollinearity is present.
4. Computational errors have been made.

Reason number three has been checked for each model and isn't a likely cause. We must also assume that the software package does not make computational errors, so reason four is also unlikely. Reason two is also unlikely as the JMP software's stepwise function was used to create the model. This function brings in every available regressor and only dismisses it from the model if it adds no value or less value than a similar regressor. That leaves reason number one as the likely cause for the reversed sign. According to Montgomery, et al, " ..if the levels of x are all close together, the variance of the least squares estimators will be relatively large. In some cases the variance can be so large

that a negative estimate (for example) of a regression coefficient that is really positive results." (Montgomery, 2001: 120)

MLR Question 35 Model Conclusions

The final model for question 35, "I feel free to suggest new and better ways of doing things" included four independent variables that explained 77% of the variance around the dependent variable. The four predictors, in order of their strength, were questions 38, 30, 5, and 39.

Question 38: "Suggestions made by unit personnel are implemented in our daily work activities."

This question was by far the strongest predictor of the four independent variables in this model and was positively related to question 35.

Question 30: "My supervisor looks out for the best interest of my workgroup."

This predictor was negatively related to the dependent variable. The negative relation here seems unreasonable, just as with question 23 in the first model. With a small n of only 23, it is reasonable to assume that this sign may be switched do to reason number one presented above; the range of some of the regressors is too small.

Question 5: "My job requires me to use a variety of skills."

This question was the third strongest indicator and was positively related to question 35.

Question 39: "The leaders in my chain of command (in my unit) listen to my ideas."

This predictor also had a positive relationship to the dependent variable. From these findings we can suggest two more propositions:

P2: Units that listen to and implement their personnel's ideas are more innovative.

P3: Units that have personnel with a wide breadth of skills are more innovative.

MLR Question 55 Model Conclusions

The final model for question 55, "My unit encourages appropriate risk taking", included two independent variables that account for 82% of the variation around the independent variable. The two variables included in the model were questions 57 and 39.

Question 57: "My unit adapts to change well."

This question was positively related to question 55 and it was the strongest predictor of the two in the final model. From this model, the following proposition is presented:

P4: Units that adapt to change are more innovative.

Question 39: "The leaders in my chain of command (in my unit) listen to my ideas."

This question was also positively related and supports P2 presented in the question 35 model.

MLR Question 56 Model Conclusions

The final model for question 56, "My unit challenges old ways of doing business", included four independent variables that account for 88% of the variation around the independent variable. The four variables included in the model were questions 57 and 41, 48, and 52.

Question 57: "My unit adapts to change well."

As in the model above, question 57 is positively related to the dependent variable and is the strongest predictor. This finding supports P4.

Question 41: "I trust the leaders in my chain of command."

This predictor is also positively related to question 56 leading to the following proposition:

P5: Organizations with trusted leaders are more innovative.

Question 48: "I would recommend an assignment in my unit to a friend."

This question was the next strongest predictor and was negatively related to the dependent variable. This regressor may be showing a negative slope due to the small range of the data points as seen in the first two models. While the first two regressors with negative slopes seemed to contradict common sense and expectations of this study, this finding neither contradicts nor supports any expectations. Because this is an inductive study, the proposition from this regressor was included so that it may be tested in further studies to see if it is supported or not. The expectation is that future research would not support this proposition, but that will remain unknown until it is tested.

P6: Units with low morale are more innovative.

Question 52: "I have the right tools/equipment to accomplish my job."

This question was the next strongest indicator and it was also positively related to the dependent variable. From this finding, the following proposition is presented:

P7: Personnel must be equipped with the proper tools and equipment to help foster an innovative atmosphere within an organization.

Overall MLR Conclusions

The propositions presented by the regression portion of this study are not expected to be all inclusive of factors affecting innovation, nor can a claim be made that they absolutely are precursors to an innovative organization. This study is the initial step in the research process. Its goal was to present testable propositions, where there were none, which can be studied and tested in further research. The propositions presented from this portion of the study are summarized below.

P1: Organizations with heavy work loads and good teamwork are more innovative
P2: Units that listen to and implement their personnel's ideas are more innovative.
P3: Units that have personnel with a wide breadth of skills are more innovative.
P4: Units that adapt to change are more innovative.
P5: Organizations with trusted leaders are more innovative.
P6: Units with low morale are more innovative.
P7: Personnel must be equipped with the proper tools and equipment to help foster an innovative atmosphere within an organization.

Propositions P2 and P4 were supported by 2 of the four models developed. All of the presented propositions, with the possible exception of P6, seem reasonable based on the literature review and comparisons with commercial entities.

Content Analysis Conclusions – Innovation

There was only one positive trend and one negative trend identified when doing content analysis on the comment section using the keyword "innovation". The negative trend showed that five of the 14 negative responses that used the term innovation believed that there was no management support for innovation or innovative ideas within their organizations. On the other hand, six of the 13 positive responses reported that they felt that innovation was supported and encouraged in their organization.

Two conclusions can be drawn from this information. The first is, due to the relatively small number of responses that used the word innovation or one of its derivatives, innovation did not appear to be a major topic in the minds of the respondents. This may simply be because innovation is not a word that people use often in their vocabulary or it may be because there is not enough emphasis placed on instilling an innovative mindset within the organization. The second conclusion was that since both the positive and negative trends were remarkably similar in the number of occurrences, and the findings directly opposed one another on the issue of management support for

innovation, that there are organizations/units within ASC that encourage innovation and organizations that discourage innovation. An interesting follow-on study might be to find both the organizations that are perceived to foster innovation and those that are not and do comparison studies to see which practices may be leading to the acceptance or rejection of innovation within these organizations.

Content Analysis Conclusions – Idea/Suggestion

The content analysis for the keywords "idea" and "suggestion" have been combined to form conclusions due to their interchangeability. There were 229 responses that included the keyword idea and 82 that included suggestion for a total of 311 responses. Of these, 156 were coded neutral or not applicable, 103 were negative and 52 were positive.

There were seven trends noted within the negative responses. The most prevalent, with 34 responses was the feeling that the respondent's ideas were ignored or not listened to within their organizations. The next trend, with 12 similar responses, was that the people felt like they were not asked for their ideas or that there was not a forum in their organization in which they could share their ideas. The next strongest trend had 10 responses that indicated that the respondents felt that their ideas were listened to but never implemented. One respondent claimed that management only paid "lip service" to ideas but never implemented them. The next trend had seven similar responses that showed a belief that ideas were only listened to and implemented within their organizations if they were directed from the top down. Another trend with seven responses showed that people felt that favoritism played a role within their organizations

in determining which ideas were listened to or implemented. Yet another trend found was the belief that the respondent's organizational culture was so resistant to change that new ideas weren't welcome. The final negative trend, with five responses, was that people felt that they were too busy to come up with new ideas.

There were only two trends noted within the 52 positive responses that contained either idea or suggestion within them. The strongest trend showed that 44 of the 52 respondents believed that their ideas were supported and encouraged within their organization. The other trend, with four responses, stated that people felt that it was good to bring new people into their organizations because they brought new ideas with them.

The first conclusion that was drawn from these findings is that there is a lot of interest by the respondents in sharing their ideas within their units. The large number of responses shows strong evidence that people want to share their ideas to better their organizations and that those that are listened to and supported appreciate that support. It also shows that those that aren't listened to or supported are frustrated and wish for an avenue to get their ideas noticed and acted upon. The fact that there appears to be substantial interest from the personnel within ASC to share their ideas is a definite opportunity for commanders and directors within ASC. Each commander and director should take a hard look at their organization to see if they are not only encouraging their people to share their ideas but also providing a process to harvest, and when appropriate, implement those ideas.

As with the innovation keyword search, there is a divide amongst the responses as to whether idea sharing is encouraged or discouraged within the respondent's organizations. This may mean that there are some organizations that support and

encourage idea sharing within their units and some that do not. The large number of responses on the issue also shows that people that feel encouraged and supported by their organizations to share their ideas, appreciate it. Those that don't feel this support and encouragement resent it.

Overall Content Analysis Conclusions

The biggest contribution of the content analysis is that there appears to be great interest on behalf of ASC personnel to share their ideas to better their organizations. This interest shows that people care about their organizations and want to see them improve. This affords a tremendous opportunity for ASC leaders to further tap into their people's potential. The opposing results indicate that there are some units in ASC that are already doing this but there are also some that are not. A secondary contribution was that it appeared that innovation and risk taking were not topics that ASC personnel were considering at the time of the survey. The findings were meager when these keyword searches were performed during the content analysis phase of the study.

Benefits and contributions

The main benefit of the regression portion of this study is that it fills a gap in innovation research and provides propositions about factors that affect innovation within military organizations. The importance of organizational innovation continues to receive more notice in both the public and private sector. These propositions can form a basis for future research on innovation within military organizations. Future research can either support some or all of these propositions or form new ones until there is a prevailing

theory that is supported and may be used to help transform organizations cultures to be more innovative.

Another benefit that can be taken away from this research is the finding that personnel are very interested in sharing their ideas on how to best improve their organizations. Those organizations that don't already have a process in place to elicit ideas from their personnel should implement one. Those that already have these processes in place should look to see if they are effective and being used. If they aren't, a better process should be initiated. Once it is determined that an organization has a good process in place for its employees to share their ideas, this process should be regularly publicized to increase awareness and use of the process.

Recommendations for Future Research

Future research on this subject should improve on the limitations of this study as mentioned in chapter three. The use of a primary survey on a larger population would be more ideal than the use of secondary data. This may not be possible do to the limitations to primary data collection such as cost, use of resources and survey fatigue of the participants. If a researcher can overcome these obstacles, then a survey instrument could be based upon the propositions presented in this paper to see if they are truly the best indicators of innovation within military organizations.

Other research that could be accomplished in this arena would be to isolate organizations that are known to encourage and support idea sharing and implementation to those that are not, and compare them to see what procedures or processes are different between the two types of organizations. The results of an effort like this could be a

benchmarked process on the best way to promote the sharing, and implementation of, new ideas within organizations.

Another interesting research approach would be to compare the propositions from this research with the literature available on organizational slack. P1 in this study states that organizations with heavy workloads are more innovative; however the literature on organizational slack indicates that people and organizations need slack time to be more creative and innovative. It would seem to make sense that if a person is very busy at work that they would look for better ways to accomplish their work in order to keep up with the demands of the job. It would be interesting to see if a "happy medium" could be found that defines the optimum mix of workload and slack time.

Another area that should be looked at as a result of this study is whether the push for innovation and intelligent risk taking is being infused throughout entire organizations from the top to the bottom. The literature shows that our top leaders are heavily touting these issues but the results of the content analysis seem to indicate that they aren't on the respondents minds. It would be interesting to see if a researcher could identify where the disconnect is, if indeed there truly is one.

Conclusion

This chapter covered the conclusions from the regression portion of this research and from the content analysis portion. Seven propositions were presented on factors that influence innovation based upon the four multiple linear regression models produced in this study. These propositions represent a starting point for future research on innovation within military organizations. Several trends that were discovered that resulted from a

content analysis on the comment section of the CSAF survey were then presented. These trends provide a snapshot of important issues to the respondents at the time of the survey. The benefits and contributions, limitations, and prospects for future research were then discussed.

Appendix: 2001 CSAF Organization Climate Survey

2001 CSAF Organization Climate Survey

(Active Duty Military and Civilians)

Note: The survey will be taken via computer

The survey is designed to reflect a system-wide analysis of your unit's organizational climate. You will see indicators for inputs (things about the job, unit-level resources, and core values), organizational processes (supervision, leadership, training and development, teamwork, recognition, and unit flexibility), and outcomes which result from a combination of these factors.

You will be asked to rate each of these on a 6-point scale (strongly disagree to strongly agree) with an option for, "Don't Know." Throughout the survey, you will be asked to answer questions which address differing groups of people in the hierarchy of your unit. Please use the definitions presented below as your reference points for these questions.

Unit: Your squadron-equivalent or your staff agency-equivalent as a whole.

Supervisor: The person to whom you report directly. Typically, this is the person who writes your performance report / appraisal.

Work Group: All persons who report to the same supervisor you do.

Unit Leadership: A reference to the leaders in your chain of command and the extent to which they influence the direction, people and culture of the unit.

Unit Commander: A reference to the unit commander (or commander equivalent) and the extent to which he/she influences the direction, people and culture of the unit.

Commander reference guide:
For most AF units, this is your squadron commander or commander equivalent.

For wing/center staff functions, this would be your wing/center commander.

For MAJCOM staff agencies, this would be your 2 letter director

For HQ USAF and SECAF staff agencies, this would be your 3 letter.

For FOAs and DRUs, this would be your commander.

The Job

Extent to which your job is motivating, important, interesting, and challenging.

	Strongly Disagree	Disagree	Slightly Disagree	Slightly Agree	Agree	Strongly Agree	Don't Know
My job requires me to use a variety of skills.	1	2	3	4	5	6	X
My job allows me to see the finished products of my work	1	2	3	4	5.	6	X
Doing my job well affects others in some important way.	1	2	3	4	5	6	X
My job is designed so that I know when I have performed well.	1	2	3	4	5	6	X
My job allows me freedom to work with minimum supervision.	1	2	3	4	5	6	X

Resources

Effective management of your unit's resources (time, personnel, and equipment) to accomplish the mission.

	Strongly Disagree	Disagree	Slightly Disagree	Slightly Agree	Agree	Strongly Agree	Don't Know
I have adequate time to do my job well.	1	2	3	4	5	6	X
We have enough people in my work group to accomplish the job.	1	2	3	4	5	6	X
I have the right tools/equipment to accomplish my job.	1	2	3	4	5	6	X
I have enough time to accomplish my daily workload during my duty hours.	1	2	3	4	5	6	X

Core Values

Extent to which the Air Force core values are understood and demonstrated by unit personnel. The Air Force core values are "Integrity First", "Service Before Self", and "Excellence in All We Do."

	Strongly Disagree	Disagree	Slightly Disagree	Slightly Agree	Agree	Strongly Agree	Don't Know
I am able to do my job without compromising my integrity.	1	2	3	4	5	6	X
Overall, people in my unit uphold high standards of excellence.	1	2	3	4	5	6	X

Overall, people in my unit demonstrate that duty takes precedence over personal desires.	1	2	3	4	5	6	X

	Strongly Disagree	Disagree	Slightly Disagree	Slightly Agree	Agree	Strongly Agree	Don't Know
Overall, people in my unit are held accountable for behavior which contradicts the AF core values.	1	2	3	4	5	6	X

Supervision

Extent to which your supervisor is perceived to be skilled at planning, organizing, directing, and providing feedback.

Answer this section in reference to the person to whom you directly report. Typically, this is the person who writes your performance report / appraisal.

	Strongly Disagree	Disagree	Slightly Disagree	Slightly Agree	Agree	Strongly Agree	Don't Know
My supervisor is good at planning my work.	1	2	3	4	5	6	X
My supervisor sets high performance standards.	1	2	3	4	5	6	X
My supervisor is concerned with my development.	1	2	3	4	5	6	X
My supervisor corrects poor performers in my work group.	1	2	3	4	5	6	X
My supervisor looks out for the best interests of my work group.	1	2	3	4	5	6	X
My supervisor provides instructions that help me meet his/her expectations.	1	2	3	4	5	6	X
My supervisor helps me understand how my job contributes to my unit's mission.	1	2	3	4	5	6	X

Unit Leadership

Extent to which your** chain of command **in your unit are influencing the direction, people, and culture of the unit.

	Strongly Disagree	Disagree	Slightly Disagree	Slightly Agree	Agree	Strongly Agree	Don't Know
Leadership, in my chain of command,	1	2	3	4	5	6	X

in my unit listens to my ideas.

Leaders, in my chain of command, in my unit are easily accessible.	1	2	3	4	5	6	X

	Strongly Disagree	Disagree	Slightly Disagree	Slightly Agree	Agree	Strongly Agree	Don't Know
I trust the leadership, in my chain of command, in my unit	1	2	3	4	5	6	X
I am proud to be associated with the leadership, in my chain of command, in my unit.	1	2	3	4	5	6	X
I see my chain of command, in my unit, doing the same things they publicly promote (walk the talk).	1	2	3	4	5	6	X
Morale is high in my unit.	1	2	3	4	5	6	X

Training and Development

Extent to which you have the training required to do your job and you are provided opportunities and support for personal growth.

	Strongly Disagree	Disagree	Slightly Disagree	Slightly Agree	Agree	Strongly Agree	Don't Know
I am given opportunities to improve my skills.	1	2	3	4	5	6	X
I am encouraged by my unit leadership	1	2	3	4	5	6	X
I have been adequately trained for the job I am expected to do.	1	2	3	4	5	6	X
I am allowed to attend continuing professional training (conferences, workshops, etc.).	1	2	3	4	5	6	X

Teamwork

Extent to which people in your work group cooperate to accomplish the mission of your unit (all persons who report to the same supervisor you do).

	Strongly Disagree	Disagree	Slightly Disagree	Slightly Agree	Agree	Strongly Agree	Don't Know
People in my work group respect each other.	1	2	3	4	5	6	X
My work group adequately resolves conflicts.	1	2	3	4	5	6	X

Members of my work group willingly. share information	1	2	3	4	5	6	X
People in my work group cooperate to get the work done.	1	2	3	4	5	6	X

Participation / Involvement

Extent to which unit personnel take part in defining what work gets done and how it is accomplished.

	Strongly Disagree	**Disagree**	**Slightly Disagree**	**Slightly Agree**	**Agree**	**Strongly Agree**	**Don't Know**
I feel free to suggest new and better ways of doing things.	1	2	3	4	5	6	X
I am asked how we can improve the way my work group operates.	1	2	3	4	5	6	X
Sufficient effort is made to get the	1	2	3	4	5	6	X
Suggestions made by unit personnel are implemented in our daily work activities.	1	2	3	4	5	6	X

Recognition

Extent to which your chain of command in your unit provides public/private acknowledgment for exceptional performance.

	Strongly Disagree	**Disagree**	**Slightly Disagree**	**Slightly Agree**	**Agree**	**Strongly Agree**	**Don't Know**
My chain of command in my unit rewards team performance fairly.	1	2	3	4	5	6	X
My chain of command in my unit rewards individual performance fairly.	1	2	3	4	5	6	X
My chain of command in my unit does a good job of recognizing people in all grades and types of jobs.	1	2	3	4	5	6	X

Unit Flexibility

Extent to which the unit responds to changes in the environment and is willing to try new things.

	Strongly Disagree	**Disagree**	**Slightly Disagree**	**Slightly Agree**	**Agree**	**Strongly Agree**	**Don't Know**
My unit adapts to changes quickly.	1	2	3	4	5	6	X
My unit encourages appropriate risk taking.	1	2	3	4	5	6	X
My unit challenges old ways of.	1	2	3	4	5	6	X

doing business

General Satisfaction

Sense of accomplishment and personal fulfillment you receive from the work you do and from the environment that surrounds you.

	Strongly Disagree	Disagree	Slightly Disagree	Slightly Agree	Agree	Strongly Agree	Don't Know
In general, I am satisfied with my job.	1	2	3	4	5	6	X
I have a sense of personal fulfillment at the end of the day.	1	2	3	4	5	6	X
The tasks I perform provide me with a sense of accomplishment.	1	2	3	4	5	6	X
I am a valued member of my unit.	1	2	3	4	5	6	X
I would recommend an assignment in my unit to a friend.	1	2	3	4	5	6	X

Unit Performance Outcomes

Extent to which your unit is satisfying its mission, goals, and objectives.

	Strongly Disagree	Disagree	Slightly Disagree	Slightly Agree	Agree	Strongly Agree	Don't Know
The quality of work in my unit is high.	1	2	3	4	5	6	X
The quantity of work accomplished in my unit is high.	1	2	3	4	5	6	X
My unit is known as one that gets the job done.	1	2	3	4	5	6	X
My unit is successfully accomplishing its mission.	1	2	3	4	5	6	X

Job Enhancement

Employee behavior that is above and beyond the call of duty and may not be formally rewarded, but is critical nonetheless for unit effectiveness.

	Strongly Disagree	Disagree	Slightly Disagree	Slightly Agree	Agree	Strongly Agree	Don't Know
In my unit, people help each other out when they have heavy workloads.	1	2	3	4	5	6	X
In my unit, people make innovative	1	2	3	4	5	6	X

suggestions for improvement.

In my unit, people willingly give of their time to help members who have work-related problems.	1	2	3	4	5	6	X

	Strongly Disagree	**Disagree**	**Slightly Disagree**	**Slightly Agree**	**Agree**	**Strongly Agree**	**Don't Know**
In my unit, people willingly share their expertise with each other.	1	2	3	4	5	6	X

General Comments:

List ONE thing that is good/going well in your organization.

List ONE thing that needs improvement in your organization.

This area is for general comments.

Bibliography

Amobile,Teresa M. and Conti, Regina. "Assessing the work environment for creativity," *Academy of Management Journal,* 39: 1154-1185 (October 1996).

Chen, Eric and Ho, Kathryn Kai Ling. "Demystifying Innovation,"*Perspectives on Business Innovation,* 8: 46-52 (2002).

Damanpour, Fariborz. "Innovation type, radicalness, and the adoption process," *Communication Research*, 15: 545-567 (October 1988).

Department of Defense. *The Defense Acquisition System.* DoD Directive 5000.1. Washington, DC: Government Printing Office, 2000.

Drazin, Robert and Schoonhoven, Claudia Bird. "Community, population, and organizational effects on innovation: A multilevel perspective," *Academy of Management Journal,* 39: 1065-1084 (October 1996).

Freeman, C. *The economics of industrial innovation*. London: Francis Printer, 1982.

Funk & Wagnalls Standard Dictionary. New York: Harper,1980.

Gluck, Frederick W. *Big Bang Management. Frontiers in Creative and Innovative Management.* Cambridge, MA: Ballinger. 1985.

Hammer, Michael and Champy, James. *Reengineering the Corporation,* New York: Harper Business, 2001.

Kanter, R. "When a thousand flowers bloom: Structural, collective and social conditions for innovation in organizations," *Research in Organizational Behavior*, 10: 160-211 (1983).

Kelley, Tom*, The Art of Innovation*. New York: Doubleday, 2001.

Kiecolt, Jill K., Nathan, Laura E., *Secondary Analysis of Survey Data,* Beverly Hills, CA: Sage, 1985.

Klemm, William, R. "Leadership: Creativity and Innovation," *AU-24 Concepts for Air Force Leadership*: 1-20 (September 2001).

Leifer, Richard, O'conner, Gina Colarelli and Rice, Mark "Implementing radical innovation in mature firms: The role of hubs," *Academy of Management Executive,* 15: 102-114 (August 2001).

Low, Jonathan and Kalafut, Pam Cohen. *Invisible Advantage: How intangibles are driving business performance*. New York: Perseus, 2002.

Mang, Paul Y. "Strategic innovation: Constantino Markides on strategy and management," *Academy of Management Executive,* 14: 43-46 (August 2000).

McClave, James T., Benson, George P., and Sincich, Terry. *Statistics for Business and Economics.* Upper Saddle River, NJ: Prentice Hall, 2001.

Neely, Andy. *Innovation and Business Performance: A Literature Review*, The Judge Institute of Management Studies. University of Cambridge, January 1998.

Nohria, Nitin and Gulati, Ranjay. "Is Slack good or bad for innovation?" *Academy of Management Journal,* 39: 1245-1265 (October 1996).

Pardo, Theresa A., Cresswell, Anthony M., Zhang, Jing and Thompson, Fiona. "Interorganizational knowledge sharing in public sector innovations," *Academy of Management Proceedings:* A1-A7, (2001).

Royse, David, *Research Methods in Social Work,* Chicago, Ill: Nelson Hall, 1999.

Stinson, Benjamin P. *Understanding how program managers successfully manage innovation in major defense acquisition programs (MDAPs): An exploratory study.* MS Thesis, Naval Post Graduate School, Monteray, CA., March 2001.

Sutherland, David, Hartmann, Jochen, and Seidel, Markus "From roadway to roadmap: Managing innovation at BMW," *Perspectives on Business Innovation,* 8: 33-38 (2002).

Tucker, Sharon and Nord, Walter R. *Implementing Routine and Radical innovations*. Lexington, MA: Lexington Books, 1987.

Van de Ven, Andrew H. "Central problems in the management of innovation," *Management Science*, 32: 590 (May 1986).

Wolfe, Richard A. "Organizational Innovation: Review, Critique and suggested research directions'" *Journal of Management Studies*, 31: 405-431 (May 1994).

Vita

Captain Eric D. Feil graduated from Herbert Hoover High School, Glendale, California in May 1987.

He enlisted in the United States Air Force in August of 1987. Upon graduation from basic training, Eric went to Keesler AFB, MS for technical training in the Automatic Tracking Radar career field. Eric attained the rank of Staff Sergeant during his seven year enlisted career.

Captain Feil earned an Associates of Science degree in Electronic Systems Engineering from the Community College of the Air Force in 1992. He accepted a Reserve Officer Training Corps (ROTC) scholarship and graduated with a Bachelor of Science degree in Business Management from Charleston Southern University in May, 1996. Upon graduation he was commissioned through ROTC on May 25, 1996.

Eric's first assignment after commissioning was to the operational contracting squadron at McChord AFB, Washington. His next assignment was to DCMC Boeing Seattle where he served as a Program Integrator, Administrative Contracting Officer and Executive Officer. During this assignment he also deployed to Camp Monteith, Kosovo for six months. In July 2001, Captain Feil continued his education by entering the Graduate School of Engineering and Management at the Air Force Institute of Technology. Upon graduation he will be assigned to ASC/LPK, Wright-Patterson AFB, OH. Eric is married and has two daughters.

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14. ABSTRACT

In response to the Air Force transformation movement there is currently a lot of high level interest in instilling cultures that promote innovation and intelligent risk taking in Air Force organizations. This thesis analyzed data collected during the 2002 Chief of Staff of the Air Force Organizational Climate Survey to identify factors that affect innovation within Aeronautical Systems Center (ASC) organizations. A secondary purpose of this study was to identify current enablers or barriers to innovation within these organizations. The first part of the study utilized multiple linear regression to identify the factors within the survey that were most related to the questions that measured innovation. These results were used to form propositions about factors that affect innovation within ASC organizations. The second part of the study utilized content analysis techniques on the comment section of the survey to identify current trends that may be enabling or blocking innovation within the participating organizations. The results of the study include seven propositions about factors that influence innovation that can be tested in follow-on research and several trends that provide insight into ASC personnel's thoughts on innovation at the time that the survey was administered.

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